connected to the shaft. The shaft is subjected to torque causing torsional deformation which is measured as an angle. Power output is determined as the product of the angle and a predetermined calibration coefficient.--

**IN THE CLAIMS:**

Please cancel claims 1-36.

Please add new claims 37-71 as follows:

--37. A method of measuring twist in a rotating shaft which is subjected to torque, between a datum point on the shaft and a measure point on the shaft longitudinally spaced from the datum point, the method including

establishing a datum time period between a datum time moment the datum point passes a stationary datum station and a time moment the measure point passes a stationary measure station under a no load condition and recording rotational speed of the shaft as the datum speed;

measuring a measure time period between a time moment the datum point passes the stationary datum station and a time moment the measure point passes the stationary measure station when the shaft is subjected to torque, recording the rotational speed of the shaft as the measure speed and establishing a length of the shaft over which torque is applied;

calculating the twist in the shaft on the basis of the difference between the measure time period and the datum time period, the measure speed and the length over which torque is applied.

38. A method as claimed in Claim 37 in which a torque point at which torque is applied to the shaft and a load point at which a load is connected to the shaft are longitudinally spaced, the shaft being stressed and undergoing twist between the torque point and the load point, one of the measure point and the datum point being positioned along said stressed portion of the shaft, the other of the measure point and the datum point being positioned in a relaxed portion of the shaft beyond one of the torque point and the load point.

39. A method as claimed in Claim 38 in which the shaft is a crankshaft of a reciprocating internal combustion engine.

40. A method as claimed in Claim 39 in which the reciprocating engine includes a ring gear having gear teeth at one end of the crankshaft and a disc at an opposed end of the crankshaft, the datum point being on the disc, the measure point being on a gear tooth of the ring gear.

9d9 Contu.d

41. A method as claimed in Claim 40 which is performed in respect of a plurality of measure points and a plurality of datum points, the plurality of measure points being on a corresponding plurality of gear teeth of the ring gear and the plurality of datum points being points which are circumferentially spaced on the disc.

42. A method as claimed in Claim 41 in which the reciprocating internal combustion engine includes a plurality of cylinders, the method being performed in respect of each cylinder.

43. A method as claimed in Claim 41 which is performed for each power stroke of the reciprocating internal combustion engine.

44. A method as claimed in Claim 38 in which the shaft is a main shaft of a gas turbine engine.

45. A method as claimed in Claim 44 in which at least one of the datum point and the measure point is on a vane of at least one of a compressor and a turbine of the gas turbine engine:

46. A method as claimed in Claim 45 which is preformed in respect of a plurality of measure points and a plurality of datum points, the plurality of measure points being on a corresponding plurality of vanes of one of the compressor and the turbine and the plurality of datum points being on a corresponding plurality of vanes of the other of the compressor and the turbine, the sensors being external of casings surrounding respectively the compressor and the turbine.

47. A method as claimed in Claim 37 in which establishing the time moments includes triggering a sensor at respectively the datum station and the measure station by means

of triggers at correspondingly the or each datum point and the or each measure point, creating a signal by each sensor and recording the signal against time.

9/4 91 Confused

48. A method as claimed in Claim 47 in which the triggers are masses of magnetic material, and the sensors are responsive to said magnetic material to create said signals.

49. A method as claimed in Claim 47 in which the triggers are optically detectable surfaces, and the sensors sense passing of the triggers. optically.

50. A method of measuring twist in a rotating shaft which is subjected to torque including sensing and recording a datum time moment when a datum point on the shaft passes a fixed datum station; sensing, at a fixed measure station, an arrival time moment of a measure point on the shaft, longitudinally spaced from said datum point by a predetermined distance; measuring a measure time period between said datum time moment and said arrival time moment; measuring rotational speed of the shaft; comparing the measure time period with a computed time period under a no load condition; and calculating the twist in the shaft on the basis of the time lag and the rotational speed.

51. A method as claimed in Claim 50 which includes empirically predetermining a datum time period between a datum time moment and an arrival time moment under a no load condition at a determined rational speed, and computing a computed time period and a computed arrival moment for any specific rotational speed on the basis of the datum time period bearing in mind the respective rotational speeds.

52. A measuring apparatus for measuring twist in a rotating shaft which is subjected to torque, the measuring apparatus including

at least one datum trigger at a datum point on the shaft;

a datum sensor at a stationary datum station arranged to sense said at least one datum trigger when said at least one datum point is in register with the datum station and to generate correspondingly at least one datum signal;

Gdd 91 contd

at least one measure trigger at correspondingly at least one measure point on the shaft longitudinally spaced from said at least one datum point;

a measure sensor at a stationary measure station arranged to sense said at least one measure trigger when said at least one measure trigger is in register with the measure station and to generate correspondingly at least one measure signal;

a clock keeping time;

a rotational speed meter for measuring and recording rotational speeds of the shaft against time respectively as the datum speed and as the measure speed;

recording means for recording said datum and measure signals against time;

a processor programmed to establish

correspondingly at least. one datum time period between a time moment said at least one datum point passes the datum station and a time moment said at least one measure point passes the measure station under no load conditions and recording the rotational speed of the shaft as the datum speed,

correspondingly at least one measure time period between a time moment said at least one datum point passes the stationary datum station and a time moment said at least one measure point passes the stationary measure station when the shaft is subjected to torque and recording the rotational speed of the shaft as the measure speed, and

the twist in the shaft on the basis of the difference between said at least one measure time period and said at least one datum time period, the measure speed and a length of the shaft over which torque is applied.

53. A measuring apparatus as claimed in Claim 52 in which the shaft includes a torque point at which torque is applied to the shaft in use and a load point at which a load is connected to the shaft in use, the torque point and the load point being longitudinally spaced, the shaft, in use, being stressed and undergoing twist between the torque point and the load point, one of the or each measure point and the or each datum point being positioned along said stressed portion of the shaft, the other of the or each measure point and the or each datum point being positioned in a relaxed portion of the shaft beyond one of the torque point and the load point.

54. A measuring apparatus as claimed in Claim 53 in which the shaft is a crankshaft of a reciprocating internal combustion engine.

add 91 continued

55. A measuring apparatus as claimed in Claim 54 which includes a plurality of measure points and a plurality of datum points.

56. A measuring apparatus as claimed in Claim 55 in which the reciprocating engine includes a ring gear having gear teeth at one end of the crankshaft and a disc at an opposed end of the crankshaft, the datum points and the measuring points being respectively on gear teeth of the ring gear and at circumferentially spaced positions on the disc.

57 . A measuring apparatus as claimed in Claim 53 in which the shaft is a main shaft of a gas turbine engine.

58. A measuring apparatus as claimed in Claim 57 in which at least one of the datum point and the measure point is on correspondingly at least one of a vane of a compressor and a vane of a turbine of the gas turbine engine.

59. A measuring. apparatus as claimed in Claim 58 which includes a plurality of datum points and a plurality of measure points, the datum points and the measure points being respectively on vanes of the compressor and the turbine.

60. A measuring apparatus as claimed in Claim 52 in which the triggers are masses of magnetic material, and the sensors are responsive to said magnetic material to generate signals.

61. A measuring apparatus as claimed in Claim 60 in which the sensors are in the form of magnetic sensors arranged external of casings surrounding respectively the compressor and the turbine.

add 9) correct

62. A measuring apparatus as claimed Claim 52 in which the triggers are optically detectable surfaces, and the sensors are optical sensors responsive to the optically detectable triggers to generate signals.

63. A method of measuring torque in a rotating shaft, including measuring twist in the rotating shaft in accordance with Claim 37, and calculating torque on the basis of the measured twist bearing in mind a pre-established length of the shaft over which length said twist is measured, and pre-established physical characteristics of the shaft determining torque-twist behaviour of the shaft.

64. A method as claimed in Claim 63 in which said physical characteristics of the shaft determining torque-twist behaviour of the shaft are established empirically.

65. A measuring apparatus for measuring torque in a rotating shaft, which includes a measuring apparatus for measuring twist as claimed in Claim 52, in which the processor is programmed to calculate torque on the basis of the measured twist bearing in mind a pre-established length of the shaft over which length said twist is measured and pre-established physical characteristics of the shaft determining torque-twist behaviour of the shaft.

66. A method of managing operation of an engine including measuring a quantity related to torque in a drive shaft of the engine as claimed in Claim 37, comparing the measured value of said quantity related to torque to a predetermined standard value of said quantity, establishing any deviation between the measured value and the standard value and controlling an operating function of the engine in response to said establish deviation.

67. A method as claimed in Claim 66 in which said operating function of the engine is at least one of ignition timing when the engine is a spark ignition engine, injector pump timing when said engine is a diesel engine, boost pressure when said engine is turbo charged or supercharged.

68. A method as claimed in Claim 66 including automatically calibrating the measuring apparatus in respect of datum time periods when the engine is operated under a no load condition.

69. An engine including

a measuring apparatus as claimed in Claim 52;

an engine management apparatus including a comparator arranged to receive a signal indicative of a measured value of a quantity related to torque in a drive shaft of the engine from the measuring apparatus, the comparator being preprogrammed to compare said measured value with a standard value of said quantity related to torque to generate a control signal, the engine management apparatus being responsive to said control signal to control an operating function of the engine.

70. An engine as claimed in Claim 69 in which said operating function of the engine is at least one of ignition timing when the engine is a spark ignition engine, injector pump timing when said engine is a diesel engine, boost pressure when said engine is turbocharged or supercharged.

add " conched

71. An engine as claimed in Claim 70 in which the engine management apparatus is preprogrammed to calibrate the measuring apparatus in respect of datum time periods when the engine is operated under a no load condition.